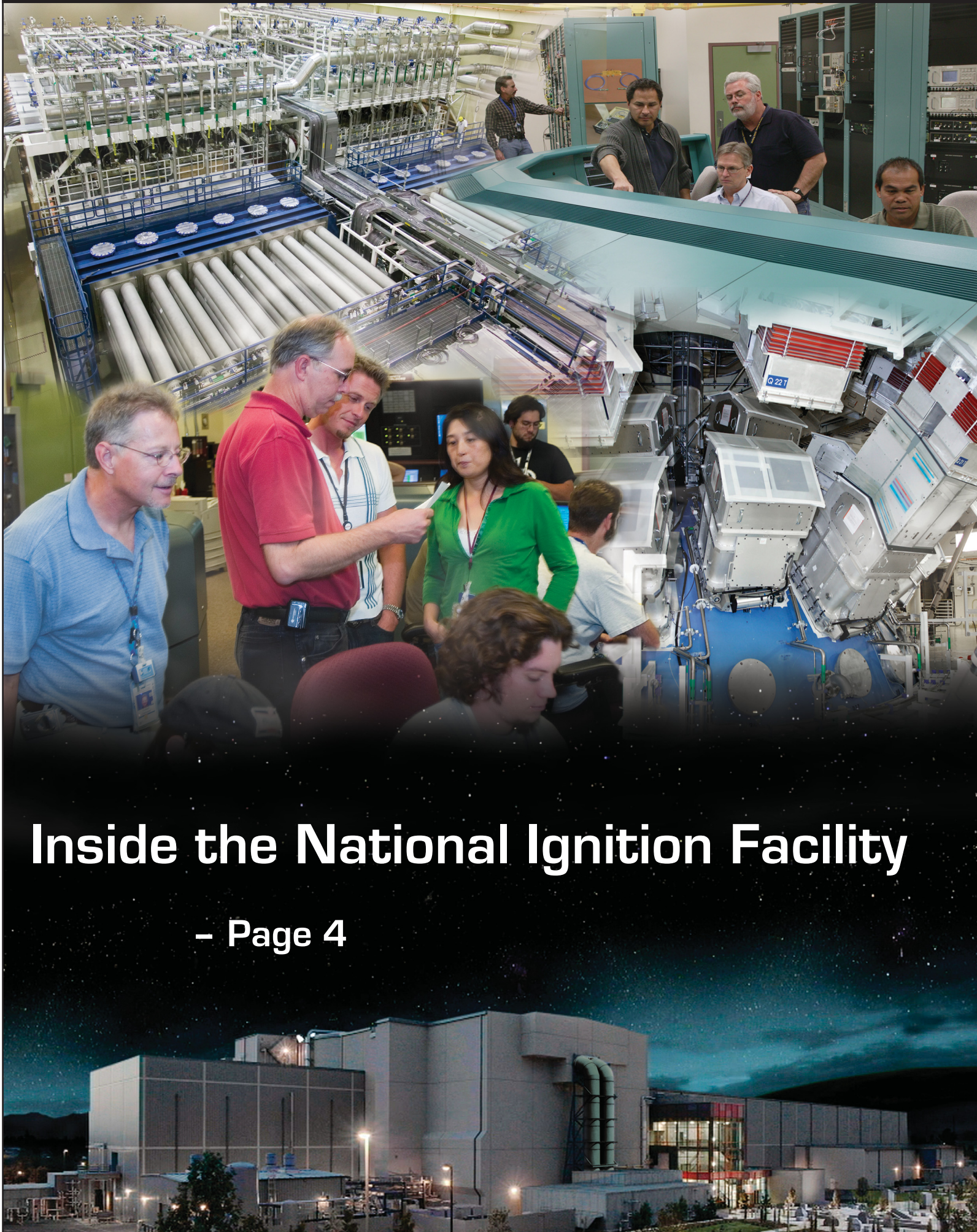


NEWSLINE

Published for the employees of Lawrence Livermore National Laboratory

January 19, 2007

Vol. 32, No. 2



Inside the National Ignition Facility

– Page 4

What's INSIDE



HONORING THE
2006 R&D 100
WINNERS

PAGE 2



SINGING THE
PRAISES OF
MARTIN LUTHER
KING JR.

PAGE 3

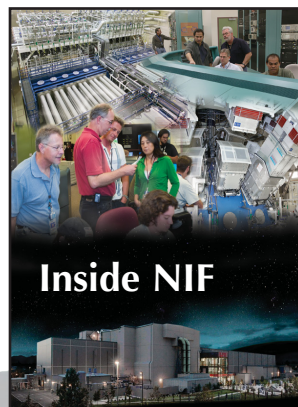


GRACE CLARK
NAMED IEEE
FELLOW

PAGE 8



The upper hemisphere of the NIF target chamber. Final optics will be installed into their positions starting later this year.



Inside NIF

ON THE COVER: CLOCKWISE FROM LEFT: ONE OF NIF'S TWO LASER BAYS; MASTER OSCILLATOR ROOM IS WHERE THE LASER BEAM BEGINS ITS JOURNEY THROUGH THE FACILITY; NIF'S LASERS ENTER THE TARGET CHAMBER IN GROUPS OF FOUR BEAMS PER ENTRY PORT; EXTERIOR OF THE NIF FACILITY AT NIGHT; CONTROL ROOM STAFF DISCUSS THE LATEST ENHANCEMENTS TO THE INTEGRATED COMPUTER CONTROL SYSTEM.

Inside the National Ignition Facility

By Bob Hirschfeld
Newsline staff writer

For most people, December is a month filled with holiday spirit, and anticipation of family, friends, and feasts. But for the National Ignition Facility (NIF), December was a hectic month, filled with record-breaking accomplishments, and the achievement of important milestones. As NIF Programs Associate Director Ed Moses explained, "NIF will soon provide capabilities for a new age of science in high energy density physics. We are excited about the progress that we have made and are on track for another great year."

The huge laser project is not scheduled to begin full-scale fusion experiments until 2010. But as equipment continues to be installed, test shots are conducted almost daily. NIF's 192 beams are evenly split among two 400-foot long rooms designated Laser Bays. Each of the two Laser Bays is further subdivided into two sets of 48 beams, each known as a cluster.

On Dec. 7, Cluster 3 in Laser Bay 2 was the first to become operationally qualified. All 48 beams within the cluster were fired simultaneously, with all subsystems participating to test end-to-end functionality. In the process, NIF became the world's most energetic laser facility, the first to achieve over a MegaJoule of infrared laser energy. Joules are a measurement of energy. The facility has now been demonstrated to have the capability of achieving 4.2 MegaJoules in the infrared. For comparison, LLNL's Nova laser typically operated just over one-percent of this energy output.

Most of NIF's test shots are extremely short, lasting just a few billionths of a second (nanoseconds). Some of the December shots utilized a bundle of eight laser beams to test NIF's so-called "long-pulse" capability, with shots lasting 25 nanoseconds. This type of shot will be used for High Energy Density (HED) experiments in support of the Stockpile Stewardship Program and for basic science experiments to explore such topics as the origin and make-up of the planets.

Another important achievement in December involved NIF's automated shot controls. The Integrated Computerized Control System (ICCS) was able to fire the entire shot cycle for Cluster 3's 48 beams including shot set up, data archiving, shot data analysis and post-shot amplifier cooling in just over three hours. This is the same time previously completed for a single bundle shot cycle and demonstrates scaling of the controls to full NIF capability.

For NIF, the New Year begins with significant momentum.

The facility has just begun around the clock operations Sunday through Friday, in preparation to eventually becoming a 24/7 operating user facility.

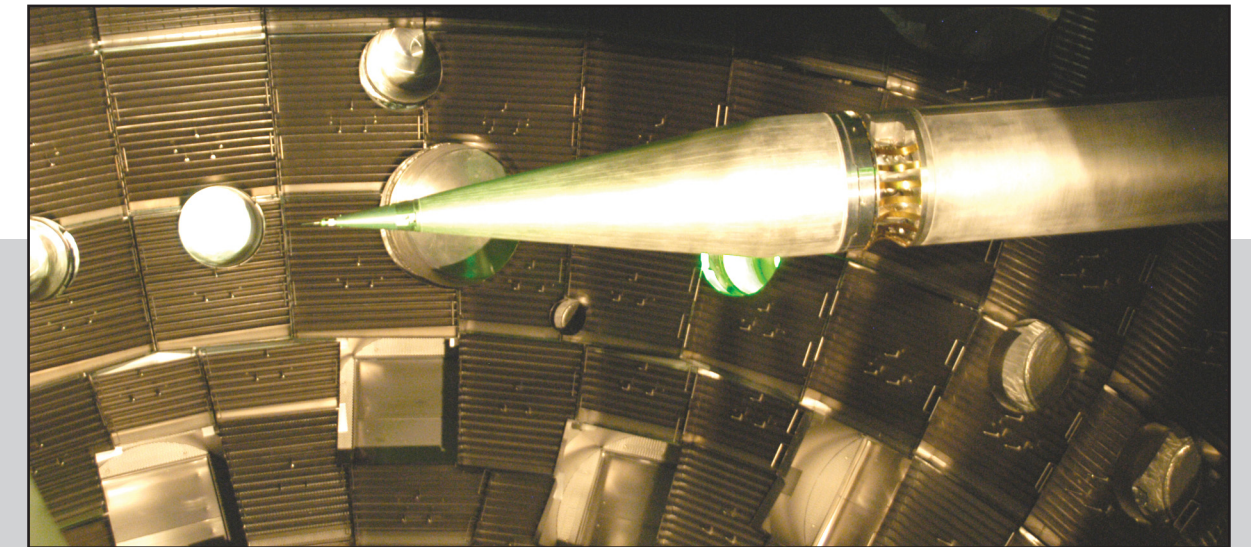
As of Jan. 3, NIF is nearly 90 percent complete, with over 3,200 of its 6,200 optical/electro-mechanical modules — known as line replaceable units (LRUs) — installed.

All of the LRUs in the NIF core comprising the Master Oscillator Room (MOR) where the laser beam originates, and the computer room have been installed.

Photos by
Bob Hirschfeld, Public Affairs



Line Replaceable Unit (LRU) being moved into position by a robotic automated guided vehicle for installation in beamline.



A retractable target positioner extends to the center of the NIF target chamber.



Prototype 2 millimeter diameter beryllium capsule suspended between two ultra-thin plastic sheets used to facilitate handling of the shell.

A look at NIF's target technology

As the National Ignition Facility heads toward completion, the enormity of the project has become apparent. Almost everything about it is huge. Its twin laser bays are each 400 feet long, amplifying beams that are about 16 inches square. The 33-foot diameter target chamber consists of a million pounds of concrete and aluminum.

But NIF's business end — the ignition capsule target — is tiny: just two mm in diameter.

NIF researchers in Bldg. 298, as well as colleagues in the Chemistry, Materials, and Life Science directorate, and at General Atomics in San Diego, are working with the target physics community to develop laser fusion targets. They are refining techniques to achieve the optimal conditions necessary for the physics of fusion to succeed.

"We're advancing a number of technologies and processes for the National Ignition Campaign (the program to achieve thermonuclear burn at NIF)," said Jeff Atherton, deputy associate director for NIF Science and Technology. "This includes tailoring the way we coat the capsules to ensure proper composition, density, and uniformity of the shells."

These capsules are positioned inside a small (one cm long) canister known as a hohlraum inside the cavernous NIF target chamber. The 192 laser beams enter the hohlraum from top and bottom creating X-rays that heat the capsule to temperatures as high as those within the sun. This creates incredible pressures that compress the fuel contained inside the capsule, forcing the atoms inside to fuse together while releasing a tremendous burst of energy.

For years, LLNL laser systems such as Nova utilized targets whose shell was a type of plastic similar to polystyrene (the material used for packing peanuts and coffee cups).

Now, the research is moving toward using beryllium, which can ignite more efficiently.

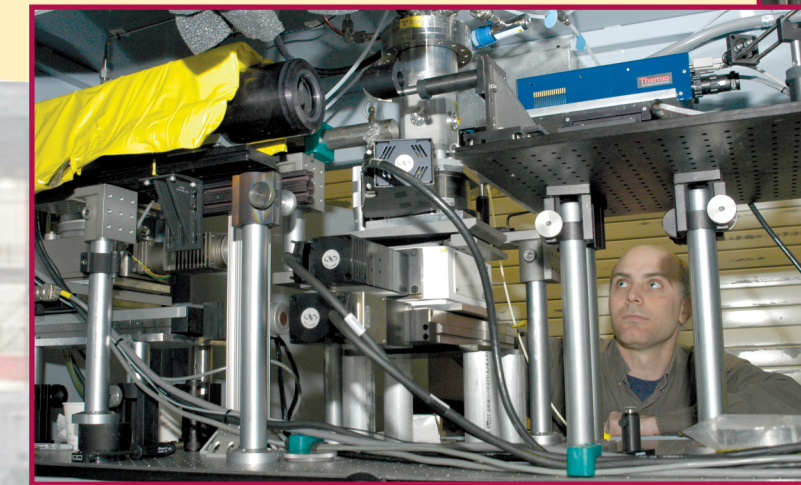
Evan Mapoles, associate program leader for NIF Integrated Target Systems, said "Beryllium has several advantages for ignition, but only if you can get it right. The team's progress to date is impressive."

Bldg. 298 houses several complex sputtering machines. Sputtering is a coating process that allows beryllium to be deposited on shells in a thin uniform layer. These machines run 24/7, coating about a dozen shells simultaneously.

Filling the tiny target with a liquid mixture of deuterium and tritium is another major effort underway in the Bldg. 298 labs. The fuel will be slowly condensed into the shell through a fill tube that is only about 10 microns in diameter. By comparison, the average human hair is about 50 microns thick.

Once inside, the liquid is frozen at just above 18 degrees Kelvin, or -427 Fahrenheit. Eventually the entire filling and freezing process will be done at the NIF target chamber in preparation for National Ignition Campaign ignition shots.

— Bob Hirschfeld



Experimental physicist Bernie Kozioziemski prepares a cryogenic refrigeration system used to study the deuterium-tritium fuel layer formed inside the target capsule.



Chemist Steve Letts operates one of the coaters in Bldg. 298 used to make prototype capsules for the National Ignition Campaign.